2018, Vol. 67, No 1, 117–120

SHORT COMMUNICATION

The Prevalence of *Campylobacter* spp. in Polish Poultry Meat

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Submitted 09 February 2017, revised and accepted 17 May 2017

Abstract

The prevalence, count and molecular identification of *Campylobacter* spp. in Polish poultry meat were analysed. 181 samples of meat from chicken (70), turkey (47), duck (54) and goose (10) were studied. *Campylobacter* spp. was found in 64% of meat samples. The highest prevalence of this pathogen was detected for duck meat. On average 80% of duck samples were contaminated with *Campylobacter* spp. The counts of *Campylobacter* spp. in positive samples remained under ten colony forming units per gram of product in 59% of poultry meat. *C. jejuni* was more frequently detected in poultry meat than *C. coli*.

Key words: *Campylobacter* spp., microbiological quality, poultry meat

During the last few decades, the global production of poultry meat has increased rapidly from 58.5 million tonnes in 2000 to 95.5 million tonnes in 2014. Production is not equally distributed; the Americas accounted for 43% of the total production, Asia (mainly China) for 34%, Europe for 17% and Africa and Oceania for 5% and 1% of the whole production in 2012 (93 million tonnes), respectively. In 2023, poultry meat is expected to be the largest meat sector by around 130.7 million tonnes (Skarp *et al.,* 2016). Chicken meat is currently the first most widely produced poultry meat followed by turkey meat, duck meat and goose meat. Although much attention has focused on microbiological safety of poultry meat, this type of product remains a significant cause of foodborne disease in the world. The most reported poultry-borne gastroenteritic disease is campylobacteriosis. In 2015 there were 229,213 cases of campylobacteriosis diagnosed (EFSA, 2016). Infection in humans is mainly caused by the zoonotic pathogen *Campylobacter* spp. Poultry is a natural host for *Campylobacter* spp. in general, and that colonized birds are the primary vector for transmitting this pathogen to humans (Bless *et al.*, 2014; Rożynek *et al.*, 2009).

Although poultry meat is becoming increasingly popular, relatively little research has been done investigating the presence and count of *Campylobacter* spp. in other than chicken types of poultry meat. In order to add more insight to these issue the objective of this study was to determine the prevalence, count and genetic diversity of *Campylobacter* spp. in different kind of poultry meat available in local trade network.

One hundred and eighty one samples of four types of commercially available fresh poultry meat were microbiologically analysed from 2013 to 2015. The samples of meat were transported to the Laboratory of Microbiology in isothermal containers, maintaining the temperature at 0–2°C, and tested immediately on reaching the laboratory. A total of 70 chicken, 47 turkey, 54 duck and 10 goose meat portions were examined in terms of the prevalence and count of *Campylobacter* spp. isolation and count were performed according to PN-ISO 10272-1:2007+Ap1:2008 and PKN ISO/TS 10272-2:2008. To confirm isolates and identify the species, polymerase chain reaction (PCR) methods was applied (Maćkiw *et al.*, 2012). For quality control, *C. jejuni* ATCC 33291 and *C. coli* ATCC 33559 strains were used. Prevalence data for *Campylobacter* spp. sorted by meat type, and species were analyzed using the analysis of variance test ANOVA (Statistica 6.0 PL). The significance level was $P < 0.05$. In case of finding

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Table I
Campylobacter spp. presence and counts in different types of poultry meat.

Meat type	No of samples	No / % of positive samples	No / % of identified strains		No of positive samples Counts [CFU/g]		
			C. jejuni	*C. coli*	< 10	≤ 100	> 100
chicken	70	49/70	36/31	13/11	23	10	16
turkey	47	18/38	12/10	6/5	12	6	0
duck	54	43/80	27/23	16/14	28	5	10
goose	10	6/60	4/3	2/2	5	1	0
total	181	116/64	79/68	37/32	68	22	26

significant differences the post-hoc analysis was done using the Tukey test.

The frequency of *Campylobacter* spp. detection and counts in the tested poultry meat is shown in Table I. Examination of the meats revealed that the vast majority of samples (64%) were contaminated with *Campylobacter* spp. The prevalence of this genus ranged from 38% to 80%, respectively for turkey and duck. The direct plating method yielded enumeration results from < 10 CFU/g to 1.0×10^3 CFU/g. Enumeration data showed the greater number of samples were positive only after enrichment (68%) indicating low microbiological load of Campylobacter on analysed poultry meat (Table I).

Of the 116 positive samples, isolates originating from a variety of poultry meat were lost in the course of freeze storage, leaving isolates from 97 samples for inclusion in the PCR analysis. Of the 97 *Campylobacter* spp. isolates, 61 and 36 were confirmed based on PCR as *C. jejuni* and *C. coli*, respectively (Table II). Variability in *C. jejuni* and *C. coli* prevalence observed in samples obtained from different types of poultry meat was not statistically significant.

Due to the lack of regulation in the EU legislation routine tests of poultry meat for the presence of *Campylobacter* spp. are not carried out in Poland (Commission Regulation (EC) No 2073/2005 as amended). Therefore, the above quantitative and qualitative assessment results of *Campylobacter* spp. prevalence in different types of poultry meat, available in Polish trade are a valuable source of information on this pathogen contamination.

In this study *Campylobacter* spp. was isolated from 64% of poultry meat. Within the tested meat types, highest *Campylobacter* spp. prevalence was found in duck (80%) followed by chicken (70%), goose (60%), and turkey (38%). Similar results were obtained by Korsak *et al.* (2015). Polish studies at the retail level revealed that 49.3% of poultry samples were contaminated with *Campylobacter* spp. Our results on the prevalence of *Campylobacter* spp. in raw poultry meat are in agreement with data from other countries (Adzitey *et al.*, 2012; Guyard-Nicodeme *et al.*, 2015; Hansson *et al.*, 2015). During the seven years of the study in the United States the average prevalence of *Campylobacter* spp. in retail broiler meat was 41%, with no statistical differences in the prevalence by year ($P > 0.05$) (Williams and Oyarzabal, 2012). In this study the prevalence of *Campylobacter* spp. in chicken meat was 70% and was lower than the frequency of contamination detected in research performed on chicken in Germany or Ireland, respectively, 87% and 91%. (Luber and Bartelt, 2007; Madden *et al.*, 2011; Moran *et al.*, 2009). The percentage obtained in our experiment for duck samples positive for this pathogen is similar to findings reported from Great Britain (Colles *et al.*, 2011), Tanzania (Nonga and Muhairwa, 2010) and South Korea (Wei *et al.*, 2014). According to Colles *et al.* (2011) and Wei *et al.* (2014) the percentage of contaminated duck samples was 93.3–100.0% and 96.6% respectively. Lower values were found by Jamali *et al.* (2015) and Rahimi *et al.* (2011). These authors detected *Campylobacter* spp. in 39.2% and 35.5% duck samples, respec-

Table II
Genotypic identification of *Campylobacter* spp.

Meat type	No of contaminated samples	No / % of strains identified to species	
		C. jejuni	*C. coli*
chicken	37	25/68	12/32
turkey	14	8/57	6/43
duck	40	24/60	16/40
goose	6	4/67	2/33
total	97	61/63	36/37

tively. The differences among results might be due to diverse isolation methods, geographic, and seasonal factors (Adzitey *et al.*, 2012; Jamali *et al.*, 2015). With regard to the range of *Campylobacter* sp. – positive samples in turkey meat, the results of Atanassova *et al.* (2007) and Rahimi and Tajbakhsh (2008) are similar to the results obtained in this investigation. Of the turkey meat examined, 34.0% and 24.7% samples were *Campylobacter* sp. positive (Atanassova *et al.*, 2007; Rahimi and Tajbakhsh, 2008). Other authors have described higher levels. Cakmak and Erol (2012) detected *Campylobacter* spp. from 45.6% of the turkey meat samples. On the other hand Noormohamed and Fakhr (2014) found in their study that 17% of the turkey samples were positive for *Campylobacter* spp. There are very few data about prevalence of microbial contamination on goose meat. The first study has shown the occurrence of *Campylobacter* spp. in 26.5% goose samples (Rahimi *et al.*, 2011). In later research reported by Jamali *et al.* (2015) prevalence was 26.1%.

Our findings showed that *C. jejuni* was more prevalent than *C. coli* in poultry meat that is in agreement with data from other countries (Ghafir *et al.*, 2007; Jamali *et al.*, 2015; Noormohamed and Fakhr, 2014; Rahimi *et al.*, 2011; Wei *et al.*, 2014; Williams and Oyarzabal, 2012). The higher prevalence of *C. jejuni* in poultry meat is contrary to the findings conducted by researchers from India, Reunion Island and Poland. Malik *et al.* (2014) observed a shift in the prevalence of important species of *Campylobacter* spp. *C. coli* were prevalent in 93.75% (30/32) and *C. jejuni* in 6.25% (2/32) among broilers slaughtered at chicken shop. Henry *et al.* (2011) also detected *C. coli* as a predominant species in chicken flocks. Maćkiw *et al.* (2012) reported that *C. coli* was the most ubiquitous. Its presence was determined in 75.5% samples of chicken meat and giblets, whereas *C. jejuni* was found in 24.5% of samples.

The quantitative results from present study showed low *Campylobacter* spp. contamination level of examined poultry meat. *Campylobacter* spp. counts were <10 CFU/g in 68% of positive cases. 22% and 26% samples showed a pathogen concentration with a range of ≥ 10 to <100 CFU/g and with ≥ 100 CFU/g, respectively. Our findings are similar to data from the Belgian monitoring program where 58% of the samples were contaminated with <10 CFU/g, 29% of the samples were contaminated with a range of ≥ 10 to <100 CFU/g and 11% of the samples were contaminated with ≥ 100 CFU/g. The average *Campylobacter* spp. concentration was 4.8×10^1 CFU/g (Habib *et al.*, 2008). The higher *Campylobacter* spp. load were found on Estonian broiler chicken products. Enumeration data, conducted by Mäesaar *et al.* (2014) showed that the overall arithmetic *Campylobacter* spp. CFU mean was 1.6×10^3 CFU/g of product. Relatively low counts obtained in our study and in research conducted by Habib *et al.* (2008) might also be considered hazardous. In a restaurant-associated outbreak, the number of *C. jejuni* bacteria in the causative chicken meal was estimated to range from 53 to 750 CFU/g. Additionally, *in vitro* models indicate that the efficiency with which some Campylobacter strains invade intestinal cell lines is optimal at the lowest range of multiplicities of infection, which suggests that species is a highly efficient solitary invader (Habib *et al.*, 2008). Our study revealed that fresh poultry meat is often contaminated with *Campylobacter* spp. that decreases the quality of this kind of meat and constitutes a public health hazards.

Acknowledgments

This research was financially supported by the Polish Ministry of Science and Higher Education (theme: 500-01-ZJ-03).

Literature

Adzitey F., G. Rusul, N. Huda, T. Cogan and J. Corry. 2012. Prevalence, antibiotic resistance and RAPD typing of *Campylobacter* species isolated from ducks, their rearing and processing environments in Penang, Malaysia. *Int. J. Food Microbiol.* 154(3): 197–205.

Atanassova V., F. Reich, L. Beckmann and G. Klein. 2007. Prevalence of *Campylobacter* spp. in turkey meat from a slaughterhouse and in turkey meat retail products. *FEMS Immunol. Med. Microbiol.* 49(1): 141–145.

Bless P.J., C. Schmutz, K. Suter, M. Jost, J. Hattendorf, M. Mäusezahl-Feuz and D. Mäusezah. 2014. A tradition and an epidemic: determinants of the campylobacteriosis winter peak in Switzerland. *Eur. J. Epidemiol.* 29(7): 527–537.

Cakmak O. and I. Erol. 2012. Prevalence of thermophilic *Campylobacter* spp. in turkey meat and antibiotic resistance of *C. jejuni* isolates. *J. Food Saf.* 32(4): 452–458.

Colles F.M., J.S. Ali, S.K. Sheppard, N.D. McCarthy and M.C.J. Maiden. 2011. Campylobacter populations in wild and domesticated Mallard ducks (Anas platyrhynchos). *Environt. Microbiol. Rep.* 3(5): 574–580.

Commission Regulation (EC) No 2073/2005 of 15.11.05 on the microbial criteria for foodstuffs, as amended.

EFSA. 2016. The European Union summary report on trends and sources of zoonoses, zoonotic agents and food-borne outbreaks in 2015. *EFSA J.* 14(12): 4634.

Ghafir Y., B. China, K. Dierick, L. De Zutter and G. Daube. 2007. A seven-year survey of *Campylobacter* contamination in meat at different production stages in Belgium. *Int. J. Food Microbiol.* 116: 111–120.

Guyard-Nicodeme M., K. Rivoal, E. Houard, V. Rose, S. Quesne, F. Gauchard and M. Chemaly. 2015. Prevalence and characterization of *Campylobacter jejuni* from chicken meat sold in French outlets. *Int. J. Food Microbiol.* 203: 8–14.

Habib I., I. Sampers, M. Uyttendaele, D. Berkvens and L. De Zutter. 2008. Baseline data from a Belgium-wide survey of *Campylobacter* species contamination in chicken meat preparations and considerations for a reliable monitoring program. *Appl. Environ. Microbiol.* 74(17): 5483–5489.

Hansson I., A. Nyman, E. Lahti, P. Gustafsson and E. Olsson Engvall. 2015. Associations between *Campylobacter* levels on

chicken skin, underlying muscle, caecum and packaged fillets. *Food Microbiol.* 48: 178–181.

Henry I., J. Reichardt, M. Denis and E. Cardinale. 2011. Prevalence and risk factors for *Campylobacter* spp. in chicken broiler flocks in reunion Island (Indian Ocean). *Prev. Vet. Med.* 100: 64–70.

Jamali H., A. Ghaderpour, B. Radmehr, K. Swee Chuan Wei, L. Ching Chai and S. Ismail. 2015. Prevalence and antimicrobial resistance of *Campylobacter* species isolates in ducks and geese. *Food Control.* 50: 328–330.

Korsak D., E. Maćkiw, E. Rożynek and M. Żyłowska. 2015. Prevalence of *Campylobacter* spp. in retail chicken, turkey, pork, and beef meat in Poland between 2009 and 2013. *J. Food Protect.* 78(5): 1024–1028.

Luber P. and E. Bartelt. 2007. Enumeration of *Campylobacter* spp. on the surface and within chicken breast fillets. *J. Appl. Microbiol.* 102: 313–318.

Maćkiw E., D. Korsak, K. Rzewuska, K. Tomczuk and E. Rozynek. 2012. Antibiotic resistance in *Campylobacter jejuni* and *Campylobacter coli* isolated from food in Poland. *Food Control.* 23: 297–301.

Madden R.H., L. Moran, P. Scates, J. McBride and C. Kelly. 2011. Prevalence of *Campylobacter* and *Salmonella* in raw chicken on retail sale in the republic of Ireland. *J. Food Protect.* 74(11): 1912–1916.

Mäesaar M., K. Praakle, K. Meremäe, T. Kramarenko, J. Sõgel, A. Viltrop, K. Muutra, K. Kovalenko, D. Matt, A. Hörman, M.-L. Hänninen and M. Roasto. 2014. Prevalence and counts of *Campylobacter* spp. in poultry meat at retail level in Estonia. *Food Control.* 44: 72–77.

Malik H., A. Kumar, S. Rajagunalan, J.L. Kataria, and A.S. Sachan. 2014. Prevalence of *Campylobacter jejuni* and *Campylobacter coli* among broilers in Bareilly region. *Vet. World.* 7(10): 784–787.

Moran L., P. Scates and R.H. Madden. 2009. Prevalence of *Campylobacter* spp. in raw retail poultry on sale in Northern Ireland. *J. Food Protect.* 9(72): 1830–1835.

Nonga H.E. and A.P. Muhairwa. 2010. Prevalence and antibiotic susceptibility of thermophilic *Campylobacter* isolates from free range domestic duck in Morogoro municipality, Tanzania. *Trop. Anim. Health Pro.* 42(2): 165–172.

Noormohamed A. and M.K. Fakhr. 2014. Prevalence and antimicrobial susceptibility of *Campylobacter* spp. in Oklahoma conventional and organic retail poultry. *Open Microbiol. J.* 10: 130–137.

PKN ISO/TS 10272-2:2008. Microbiology of food and animal feeding stuffs. Horizontal method for detection and enumeration of *Campylobacter* spp. Part 2: Colony-count technique.

Polish Standard PN-ISO 10272-1:2007+Ap1:2008. Microbiology of food and animal feeding stuffs. Horizontal method for detection and enumeration of *Campylobacter* spp. Part 1: Detection method.

Rahimi E., F. Alian and F. Alian. 2011. Prevalence and characteristic of *Campylobacter* species isolated from raw duck and goose meat in Iran. *IPCBEE* 9: 171–175.

Rahimi E. and E. Tajbakhsh. 2008. Prevalence of *Campylobacter* species in poultry meat in the Esfahan city, Iran. *Bulg. J. Vet. Med.* 11(4): 257–262.

Rożynek E., K. Dzierżanowska-Fangrat, B. Szczepańska, S. Wardak, J. Szych, P. Konieczny, P. Albrecht and D. Dzierżanowska. 2009. Trends in antimicrobial susceptibility of *Campylobacter* isolates in Poland (2000–2007). *Pol. J. Microbiol.* 58(2): 111–115.

Skarp C.P.A., M.L. Hänninen and H.I.K. Rautelin. 2016. Campylobacteriosis: the role of poultry meat. *Clin. Microbiol. Infec.* 22(2): 103–109.

Wei B., S.Y. Cha, M. Kang, J.H. Roh, H.S. Seo, R.H. Yoon and H.K. Jang. 2014. Antimicrobial susceptibility profiles and molecular typing of *Campylobacter jejuni* and *Campylobacter coli* isolates from ducks in South Korea. *Appl. Environ. Microbiol.* 80(24): 7604–7610.

Williams A. and O.A. Oyarzabal. 2012. Prevalence of *Campylobacter* spp. in skinless, boneless retail broiler meat from 2005 through 2011 in Alabama, USA. *BMC Microbiol.* 12: 184–190.